Infiltration BMPs: Caltrans Retrofit Pilot Study Experience

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Infiltration for Stormwater Management…

Why?

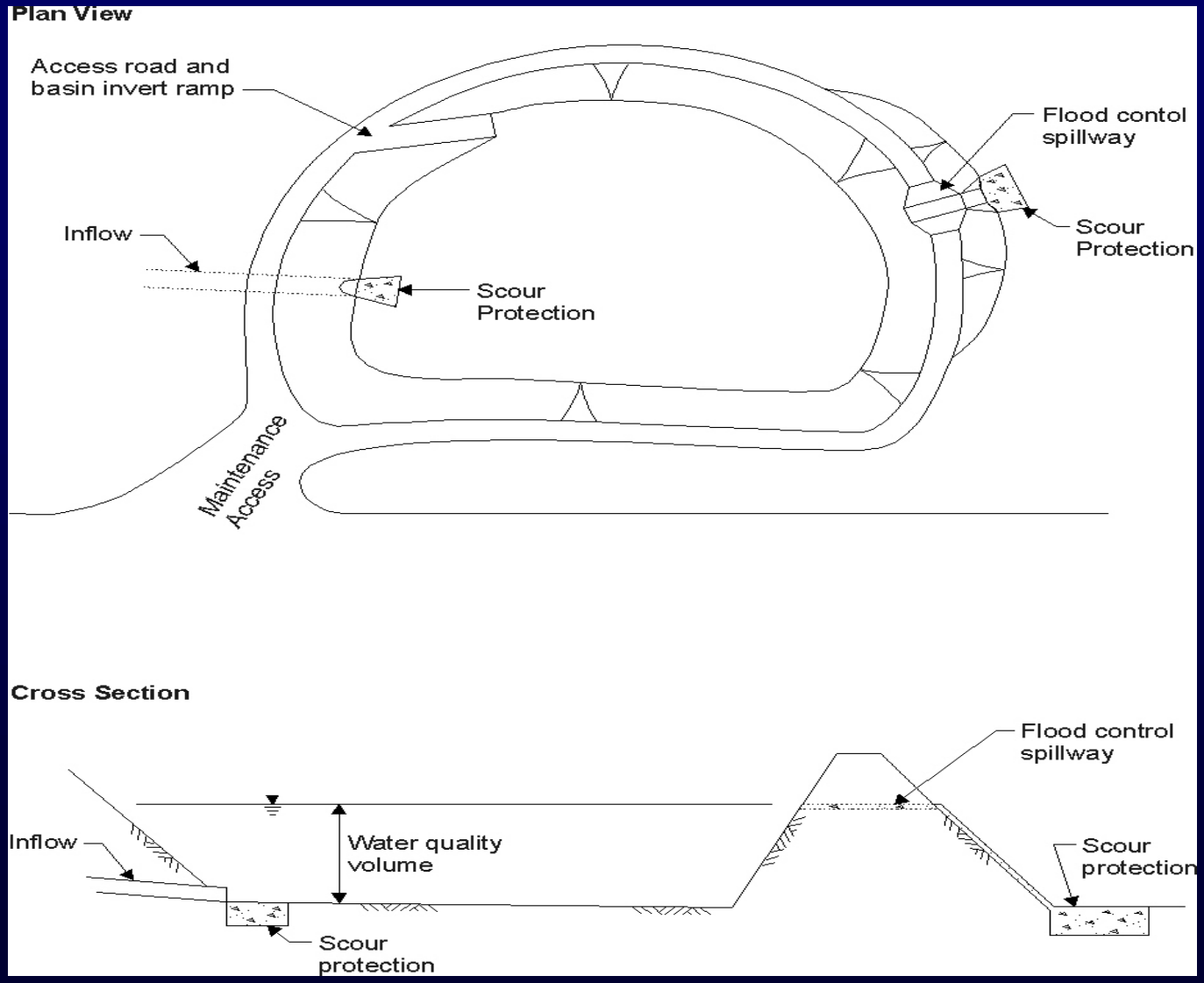
- Reduce surface water discharges and comply with NPDES regulations

How?

- Basins
- Trenches

Siting and Design Criteria…

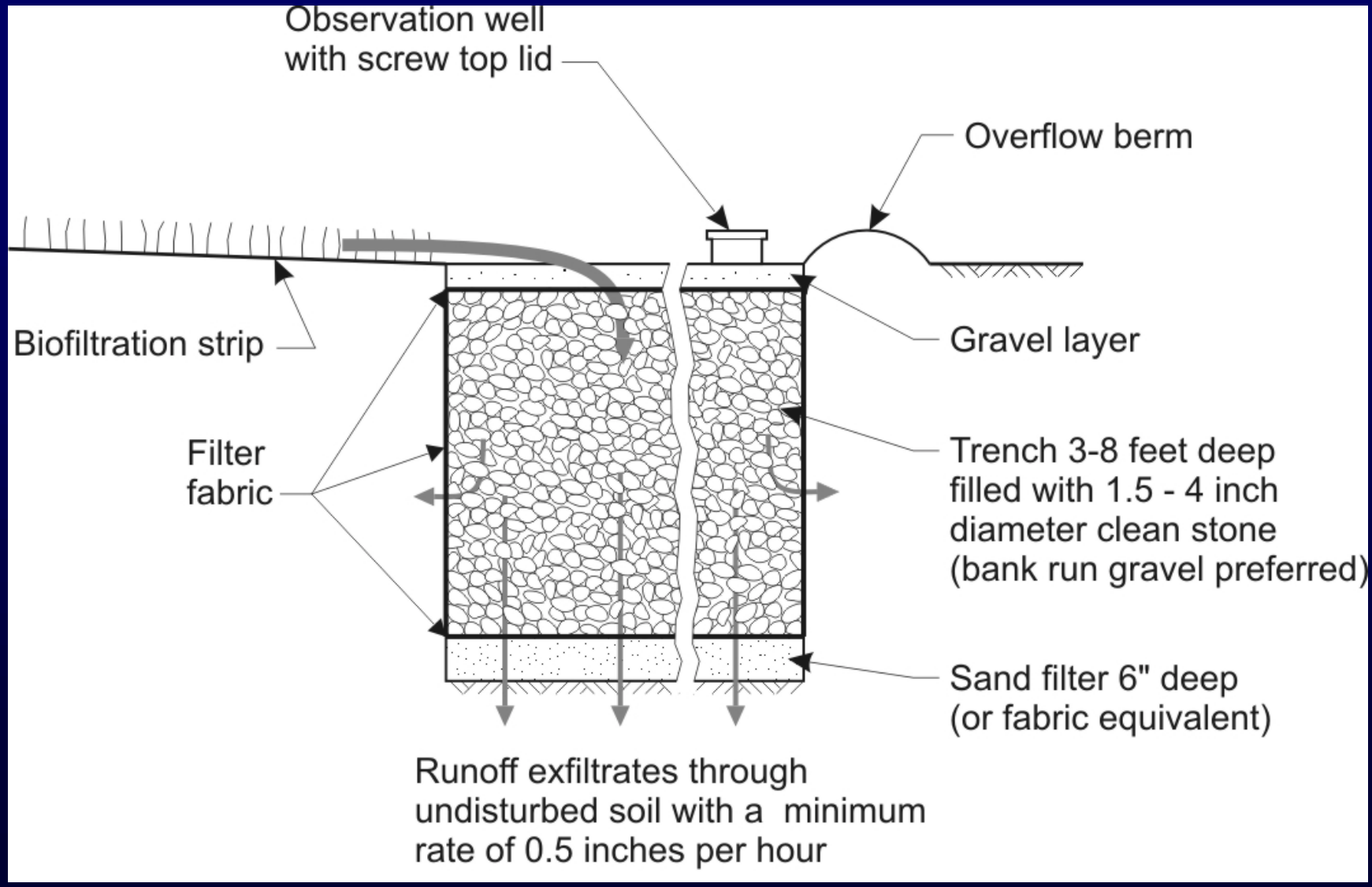
Typical Basin Design



Design Procedure Used…

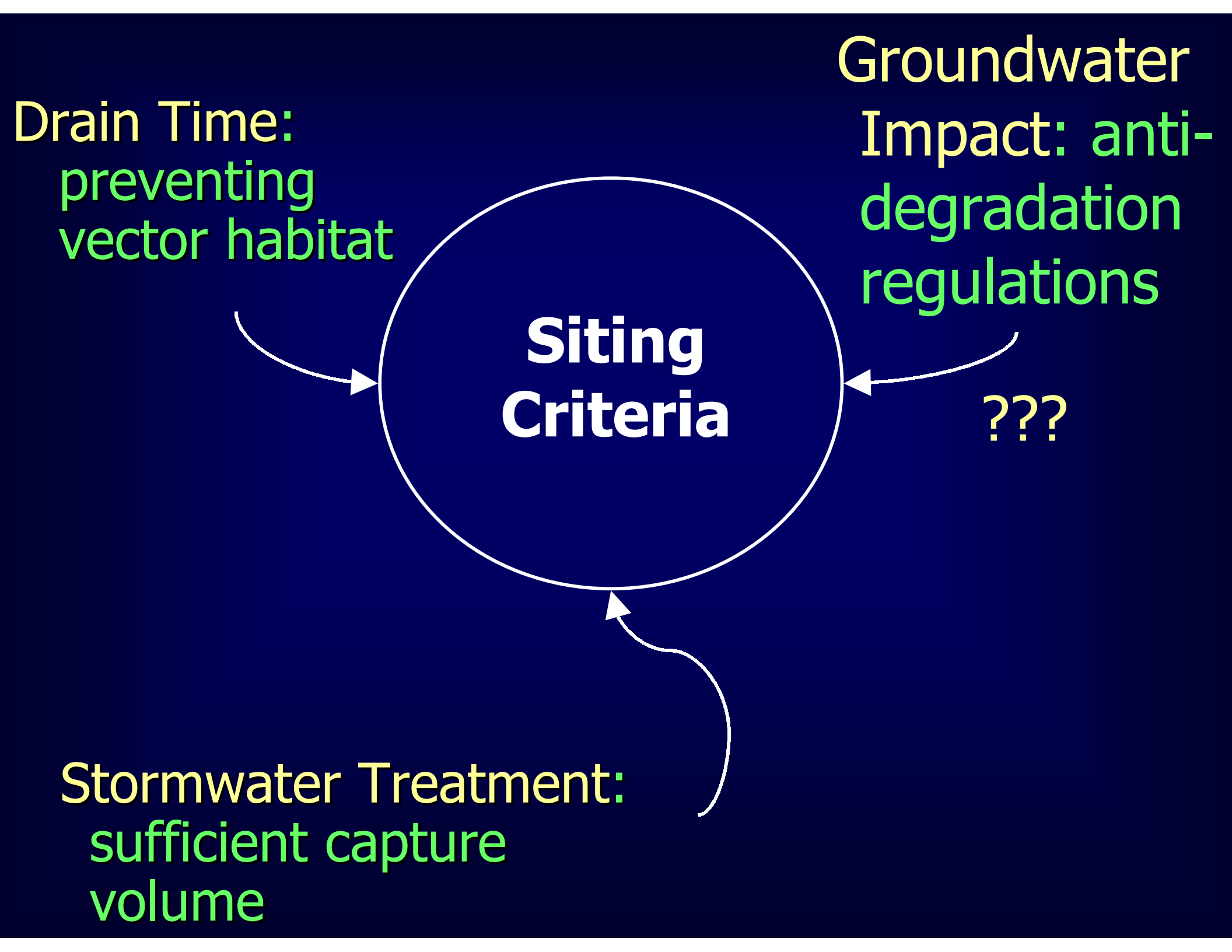
- It varied…L.A. basin sized to drain in 36 hours
- S.D. basin sized to drain in 72 hours (maximum recommended)
- A=V/(T*f)
  - A = area of basin,
  - V = capture volume,
  - f = field permeability,
  - T = drain time

Typical Trench Design



Infiltration Challenges…

- Stormwater treatment
- Vectors (Mosquito Habitat)
- Groundwater impacts


Drain Time:
preventing
vector habitat
Groundwater
Impact: anti-
degradation
regulations
Siting
Criteria
???
Stormwater Treatment:
sufficient capture
volume

Siting Criteria Used

- Minimum Field Permeability of 7mm/hr (0.27 in/hr)
- Minimum Groundwater Separation of 0.6 m to 1.2 m (2-4 ft)
- Other site size, access, and setback requirements

Site Selection Process

- Infiltration Basin Site Screening
  - 14 potential sites ->
  - 5 selected for field tests ->
  - Only 2 suitable sites
- Infiltration Trench Site Screening
  - 38 potential sites ->
  - 8 selected for field tests ->
  - Only 2 suitable sites

Case Study Site Conditions

Site – BMP	Measured permeability mm/hr (in/hr)	Groundwater separation[a] m (ft)
San Diego Basin	22.3 (0.88)	0.6 (2)
Los Angeles Basin	5.8 (0.23)	9+ (30+)
Los Angeles Trench	40 (1.6)	0.6+ (2+)
San Diego Trench	31 (1.2)	0.6+ (2+)

Infiltration Trench – S.D.

Infiltration Trench – S.D.

Infiltration Trench – L.A.

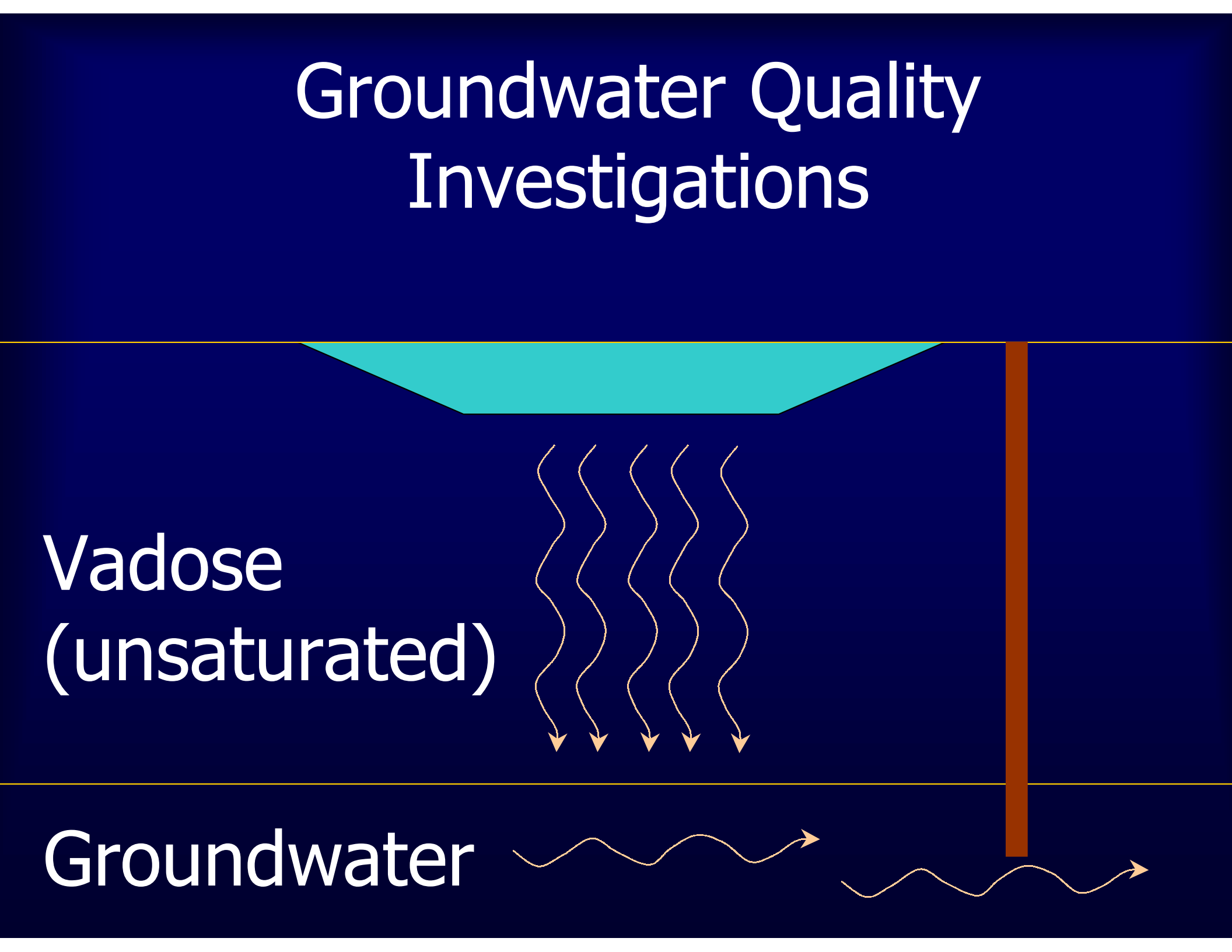
Infiltration Basin – L.A.

Failed Infiltration Basin (S.D.)

Groundwater Quality Investigations

- Vadose zone monitoring unsuccessful
- Groundwater monitoring too limited and short-term to draw reliable conclusions

Groundwater Quality Investigations



Performance Notes

- 50% of installations performed poorly
- Poorly performing infiltration BMPs was not due to insufficient maintenance
- The S.D. trench doesn't work well, despite good field test results
- The L.A. Basin works well, despite marginal infiltration rates (conservative design)
- Unknown groundwater impact

So how do we compensate for the variation in performance?

- Improve site investigations
- Revise siting criteria
- Use more conservative design procedure

Improved Site Investigations

- Multiple permeability tests at multiple locations
- If within 3 m (10 ft), perform long term groundwater level monitoring
- Check soil conditions for evidence of rising groundwater

Revised Siting Criteria

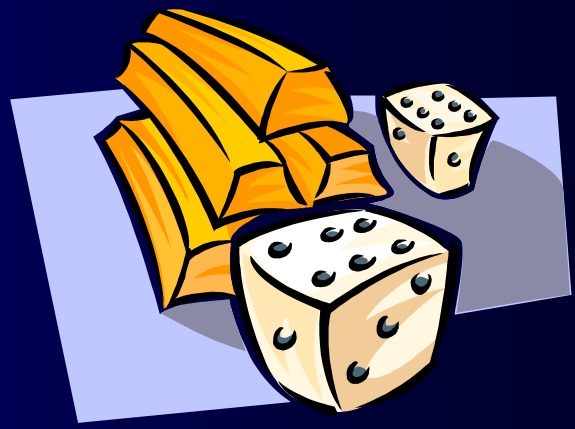
- Minimum Permeability:
  - 13 mm/hr (0.5 in/hr) is suggested in Maryland guidance
  - Lower if available land and high confidence in field tests
- Minimum Groundwater Separation:
  - 3 m (10 ft) separation would prevent siting in the failed San Diego location
  - 3 m is also suggested in literature as a minimum for groundwater protection
- Soil Type: NRCS Type A or B

More conservative Design Procedure

- Do not design for maximum allowed drain time (72 hours)
- Consider using 48 hour maximum drain time – 6 hours is recommended in many references

More conservative Design Procedure (cont.)

- Select Factor of Safety
  - FS of 0.5 applied to the lowest field measured permeability is recommended
  - Depends on soils, space available, expected maintenance intervals, and confidence in the field tests



Options to Maintain Infiltration

- Basins:
  - Scarify as needed
  - Remove sediment and regrade
- Trenches:
  - Top trench layer is removed/rock cleaned as needed
  - Complete trench reconstruction

Cautions

- Can not remove sediments on trenches without rebuilding top portion
- Is current separation guidance sufficient to protect groundwater quality?
- Typical 'pretreatment' does little for dissolved constituents
- Greater permeability usually means less groundwater protection
- California has an anti-degradation policy (68-16) requiring discharges not to exceed background levels

Acknowledgments

- Design
  - Montgomery Watson
  - RBF
- Maintenance and Monitoring
  - Law Crandall
  - Kinnetic Laboratories, Inc.

http://www.dot.ca.gov/hq/env/stormwater/index.htm